- Introduction to recalcitrant compounds.
- Toxicological exposure of bound recalcitrant compounds.
- Roadblocks to the implementation of biotreatment strategies.
- The federal integrated biotreatment research consortium (flask to field).
- Chlorinated solvent contaminated soils and groundwater: field application of the solvent extraction residual biotreatment technology.
- Enhancing PCB bioremediation.
- Polycyclic aromatic hydrocarbons (PAHs): improved land treatment with bioaugmentation.
- Future needs for research and development.

I was particularly in the chapter entitled "Enhancing PCB bioremediation" because I had met the senior author (James M. Tiedje) on several occasions, some of his work having been sponsored by the U.S. EPA's Hazardous Materials Research Program. I was a member of the Science Advisory Group of one of the centers that funded some of Dr. Tiedje's work whose objectives were to:

- Develop genetically engineered organisms that will grow on PCBs.
- Evaluate surfactants and $FeSO_4$ to enhance PCB dechlorination.
- Implement and test PCB bioremediation in pilot-scale reactors.

Conclusions drawn by Tiedje in his work are as follows:

> "Bioremediation can potentially result in dechlorination of PCBs and possibly even in mineralization of the contaminant. Energy costs are lower than other forms of treatment. Slurry phase treatment usually requires less time than solid phase biological treatment due to increased rates of contaminant mass transfer. Furthermore, it is relatively simple to maintain either aerobic or anaerobic conditions in the reactor and to switch between these two conditions .... Although results of the currently ongoing pilot test are yet to be determined, flask- and laboratory-scale soil remediation experiments indicate that the designed two-phase enhanced anaerobic dechlorination of aroclor coupled with GEM-based enhanced aerobic degradation/mineralization of lower-chlorinated PCBs could be very beneficial as a remediation technology."

The book ends with a chapter entitled "Future needs for research and development." In this chapter, Talley discusses a number of research and development issues that were identified as worthy of being followed up but were not pursued due to a desire to move the technology with the most potential to the pilot or field scale.

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D.A. Vaccari, P.F. Strom, J.E. Alleman, Environmental Biology for Engineers and Scientists, John Wiley & Sons, Inc., Hoboken, NJ, 2006 (953 pages, 7-in. × 10-in. format, US$ 115.00, ISBN 0-471-72239-1).

Today's graduating environmental engineers must be familiar with a greatly expanded body of knowledge of environmental science. If, in my opinion, they utilize the material in this book to the fullest, these new engineers will have a solid basis for their professional careers.

The book was written to serve as a text for a graduate level environmental engineering course. It was designed to familiarize students with a broad range of biological topics. The first 10 chapters (see below) cover a wide range of biological topics (the range of these topics is much wider, I might note, than what I was exposed to in my teaching career). The book contains much more material than the narrow range of microbiology topics which have been (to date) the substance of most microbiology courses for engineers.

Chapters in the first section of the book by title are:

- Perspectives on biology
- Biology as a whole
- The substances of life
- The cell: the common denominator of living things
- Energy and metabolism
- Genetics
- The plants
- The animals
- The human animal
- Microbial groups
- Quantifying microorganisms and their activity

The succeeding chapters deal with more conventional material taught in environmental engineering classes. Those chapter titles are listed below:

- Effect of microbes on human health
- Microbial transformations
- Ecology: the global view of life
- Ecosystems and applications
- Biological applications for environmental control
- The science of poisons
- Fate and transport of toxins
- Dose–response relationships
- Field and laboratory toxicology
- Toxicity of specific substances
- Applications of toxicology

The one chapter I spent the most time reading was entitled "Biological applications for environmental control." Discussed were: wastewater treatment (this section included discussions of the common wastewater treatment systems but went on to even discuss wetlands construction and the role of wetlands as a treatment device), sludge treatment, and disinfection. The authors even included information on solid waste treatment and air emissions from biofilters. The discussion ends with a section on soil and groundwater with treatment systems covering phytoremediation and bioremediation.

The chapter spans approximately 130 pages and contains 75 figures (diagrams, photographs, and plots) and 19 tables. Given the authors' backgrounds in this area, the length of this chapter is not surprising. Nor is it surprising that the chapter is very well written.

In summary, I note that this is a great text that covers a multitude of topics well, and is well written and comprehensive. I predict it will be popular as a text for environmental engineering students.

Finally, I note that there are teaching aids available (according to a note on the back cover of the book). These teaching aids include:

- Notes, problems, and solutions
- Problem sets at the end of each chapter
- PowerPoints of many figures

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